

Claims

- [c1] A Turbo Codes Decoder used as a baseband processor subsystem for iterative decoding a plurality of sequences of received data R_n representative of coded data X_n generated by a Turbo Codes Encoder from a source of original data u_n into decoded data x_n comprising of:
- (a) two pipelined SISO Log-MAP Decoders each decoding input data from the other output data in an iterative mode.
 - (b) the first SISO Log-MAP Decoder having three inputs: R_0 , R_1 connecting from the Input shift register module, and Z_1 feeding-back from the De-Interleaver Memory module output; and the first Decoder output is connected to an Interleaver Memory module.
 - (c) the second SISO Log-MAP Decoder having two inputs: R_2 connecting from the Input shift register module, and Z_2 connecting from the Interleaver Memory module output; and the second Decoder output is connected to a De-Interleaver RAM.
 - (d) an Interleaver Memory module storing decoded data from the first Log-MAP Decoder, feeding data to the second Log-MA Decoder.
 - (e) a De-Interleaver Memory module storing decoded data from the second Log-MAP Decoder, feeding-back data to the first Log-MAP Decoder.
 - (f) an Input Shift Register Buffer storing a block input un-decoded received data, and feeding data to the two Log-MAP Decoders.
 - (g) a Control logic state machine controlling the overall operations of the Turbo Codes Decoder.
 - (h) a hard-decoder logic producing a final decision of either logic zero 0 or logic one 1 at the end of the iterations.
- [c2] The Decoder system of claim c1, wherein each Log-MAP decoder uses the logarithm maximum a posteriori probability algorithm.
- [c3] The Decoder system of claim c1, wherein each Log-MAP decoder uses the soft-input and soft-output (SISO) logarithm maximum a posteriori probability algorithm.

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- [c4] The Decoder system of claim c1, wherein the Interleaver Memory module uses a permuter to generate the write-address sequences of the Memory core in write-mode. In read-mode, the memory core read-address are normal sequences.
- [c5] The Decoder system of claim c1, wherein the Interleaver Memory module uses dual-port memory RAM.
- [c6] The Decoder system of claim c1, wherein the De-Interleaver Memory module uses an inverse-permuter to generate the write-address sequences of the Memory core in write-mode. In read-mode, the memory core read-address are normal sequences.
- [c7] The Decoder system of claim c1, wherein the De-Interleaver Memory module uses dual-port memory RAM.
- [c8] ✓ A method for iterative decoding a plurality of sequences of received data R_n representative of coded data X_n generated by a Turbo Codes Encoder from a source of original data u_n into decoded data x_n comprising the steps of:
- (a) coupling two pipelined decoders, having Interleaver Memory and De-Interleaver Memory for storing decoded output and providing feedback input for the decoders.
 - (b) applying feedback signal from the output of the De-Interleaver Memory to the first decoder with the received signal input to generate a first decoded output.
 - (c) applying the first decoded output to the Interleaver Memory using the permuter to generate a memory address for storing the decoded data.
 - (d) applying the output of the Interleaver Memory to the second decoder with the received signal input to generate a second decoded output
 - applying the second decoded output to the De-Interleaver Memory using the inverse-permuter to generate a memory address for storing the decoded data
- [c9] ✓ An 8-state SISO Log-MAP Decoder for decoding a plurality of sequences of

soft-input data SD_0 and SD_1 generated by a receiver to produce decoded soft-output data Y comprising of:

- (a) a Branch Metric module computing the two soft-input data SD_0 and SD_1 into 16 branch metric values for each branch in the trellis.
- (b) a Branch Metric Memory module storing the 16 branch metric values for each stage $k = 0 \dots N$.
- (c) a State Metric module computing state metric values for each state in the trellis using branch metric values.
- (d) a State Metric Memory module storing 8 state metric values for each stage $k = 0 \dots N$.
- (e) a Log-MAP module computing the soft decision output based on the branch metric values and state metric values using log maximum a posteriori probability algorithm.
- (f) a Control Logic state machine module controlling the overall operations of the Log-MAP decoder.

- [c10] The Decoder system of claim c7, wherein the decoder uses the logarithm maximum a posteriori probability algorithm.
- [c11] The Decoder system of claim c7, wherein the decoder uses the soft-input and soft-output (SISO) logarithm maximum a posteriori probability algorithm.
- [c12] The Decoder system of claim c7, wherein the decoder uses a convolutional 8-states trellis state transition diagram.
- [c13] The Decoder system of claim c7, wherein the the branch metric module uses a binary adder, a binary Subtractor, and two binary two-complementers logic.
- [c14] The Decoder system of claim c7, wherein the the state metric module uses a binary adder, a comparator, a Mux selector logic.
- [c15] The Decoder system of claim c7, wherein the the log-map module uses binary adders, binary maximum selectors logic.

[c16]

The Decoder system of claim c7, wherein the soft decoder module uses soft decision algorithm.

[c17]

The Decoder system of claim c7, wherein the the branch metric memory module uses dual-port memory RAM.

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